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## INFORMATION CIRCULAR

# COLORADO MINE FATALITIES

BY

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Circular No. 6177
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# INFORMATION CIRCULAR

## DEPARTMENT OF COMMERCE - BUREAU OF MINES

# COLORADO COAL-MINE FATALITIES[1]

By E. H. Denny[2], C. W. Owings[3], and D. Harrington[4].

Colorado coal-mine fatalities, which have gradually decreased since 1914, have shown a marked decline since 1924. Data on coal-mine fatalities in Colorado published by the U. S. Bureau of Mines[5] indicate that the deaths per thousand 300-day workers have decreased from 9.13 in 1914 to 6.14 in 1926, and that the deaths per million tons produced have decreased from 9.18 in 1914 to 4.98 in 1926. Table 1 gives fatality rates in Colorado and in the United States from 1914 to 1926 inclusive.

Table 1.-Fatality rates in coal mines of Colorado, and in the United States, 1914 to 1926, inclusive

| Date | Deaths per thousand 300-day workers | | Deaths per 1,000,000 tons produced | |
|---|---|---|---|---|
| | Colorado | U. S. | Colorado | U. S. |
| 1914 | 9.13 | 4.90 | 9.18 | 4.40 |
| 1915 | 7.87 | 4.47 | 7.30 | 3.80 |
| 1916 | 4.23 | 3.88 | 4.10 | 3.33 |
| 1917 | 15.07 | 4.31 | 15.06 | 3.83 |
| 1918 | 5.76 | 3.97 | 5.72 | 3.50 |
| 1919 | 10.25 | 4.15 | 8.81 | 3.62 |
| 1920 | 6.00 | 3.79 | 5.70 | 3.13 |
| 1921 | 6.56 | 4.35 | 5.70 | 3.48 |
| 1922 | 8.71 | 5.16 | 7.49 | 3.99 |
| 1923 | 8.55 | 4.65 | 6.38 | 3.46 |
| 1924 | 5.72 | 5.39 | 4.21 | 3.94 |
| 1925 | 6.63 | 4.79 | 5.43 | 3.53 |
| 1926 | 6.14 | 4.86 | 4.98 | 3.60 |

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Circular 6177."

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[5] Adams, W. W., Coal-Mine Fatalities in the United States, 1924. Bull. 251, Bureau of Mines, 1925, 95 pp.

[5] Adams, W. W., Coal-Mine Fatalities in the United States, 1927. Bull. 293, Bureau of Mines, 1928, 126 pp.

The data in the following tables have been taken from the annual reports of the Colorado State Inspector of Coal Mines for the period 1913 to 1928 inclusive. The records of 34 coal mining companies, representing the principal coal production of the State of Colorado, have been abstracted. Some of these companies operated for the full 16 years and some for only a part of this period. Even those companies operating for the entire 16-year period worked out mines or started new mines during the period, so that the number of mines designated as operated in the table are usually greater than those actually operated in any one year.

The fatality rate has been figured on a "deaths per 1,000 300-day workers" or frequency basis and on a "deaths per 1,000,000 tons produced" or tonnage basis. Any accident figures based on tonnage production are strictly cost figures with little relation to the question of whether mining is becoming more or less hazardous. More efficient methods of mining have increased the tonnage output per man and therefore may show a lessened accident rate on a tonnage-output basis even though the accident rate on a time-exposure basis remains about the same. The fairest method of fatal accident comparison is on a time-exposure basis of the worker, if such time figures can be accurately obtained. However, the figures given in these tables as to men killed per 1,000 300-day workers are based on the number of days the mine (or rather the tipple) worked, as reported to the State inspector of coal mines; actually there were some men (probably in some instances many men) working in the mine on so-called idle days who were exposed to mine hazards, and some fatalities and injuries occurred on "idle" days. In Routt County, Colo., particularly, a large supply of mine cars makes it possible to mine and load coal on numerous days when the tipples are not operating; the companies with mines in that county, such as the Hayden Brothers Coal Corporation, The Colorado and Utah Coal Co., the Victor American Fuel Co., and the Moffat Coal Co., therefore have an apparently high fatal accident rate on a frequency basis as compared with the rate on a tonnage basis. When possible to get such figures, the fatality rate per million man hours of exposure is a much fairer basis of comparison.

During the 16-year period 1913 to 1928, inclusive, an average of 7.53 men (Table 2) were killed per 1,000 300-day workers, and an average of 6.38 men (Table 3) were killed per 1,000,000 tons produced. This rate is considerably higher than the average[6] of the United States for the period 1913 to 1926, inclusive (1926 being the last year for which complete figures on deaths per 1,000 300-day workers have been published); 4.36 men were killed per 1,000 300-day workers and 4.05 men per 1,000,000 tons produced. Nine of the 34 Colorado companies (Table 2) have a lower fatality rate on a frequency basis than that of the average (4.36) in the United States, while 13 (Table 3) have a lower fatality rate on a tonnage basis than that (4.52) of the whole United States. The Shamrock Coal Co. is the only one of the 34 Colorado coal companies listed (Table 4) having no fatalities in the period 1914 to 1928, inclusive; this company produced 771,853 tons of coal and worked 105,131 man days without a fatal accident. In 1928 the Shamrock Coal Co. worked 73 men. The Clayton Coal Co., with one fatality in 9 years of operation, ranks second in fatality rate with 1,626,918 tons produced and 266,370 man days worked. Both of these companies operate single mines in Weld County in the northern Colorado subbituminous field.

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[6] Adams, W. W., Coal-Mine Fatalities in the United States, 1927. Bull. 293, Bureau of Mines, 1928, p. 3.

The companies with higher accident records have in general suffered severe loss of life from mine explosions. Thus of the 212 men killed in the mines of the Victor American Fuel Co. (Table 4), 121 men were killed by an explosion at the Hastings mine in 1917 and 7 men at the Delagua mine in 1927. Of the 17 men killed in the Empire Coal Mining Co. operations, 13 men were killed in an explosion in 1919. Explosions causing loss of life also occurred in the operations of the Oakdale Coal Co., the Moffat Coal Co., the Gordon Coal Co., and the Bear Canon Coal Co.

During the period 1924 to 1928, inclusive, the Colorado coal mine fatal-accident rates decreased considerably as compared with the period 1913 to 1928, inclusive. Thus 5.99 men (Table 5) were killed per 1,000 300-day workers and 4.25 men per million tons of coal produced (Table 6), as compared with 7.53 and 6.38, respectively, for the 16-year period. This decrease was largely due to the fact that only one explosion occurred which killed more than five men (Delagua, Colo., 7 men). Three companies had no loss of life from mine accidents. The average fatality rates, however, in this five-year period still were somewhat higher than those of the United States for 1924, 1925, and 1926. Some figures have been compiled (Table 4) on nonfatal accidents during the period 1924-1928, inclusive. It has not been possible to compile these on a lost-time (severity) basis. Some companies report all accidents involving one or more days lost time, but it is suspected, from the fact that accidents involving more than 14 days lost time are reported as greater in number than those of under 14 days, that figures from other companies represent only accidents involving 14 or more days lost time. Of the 9,352 injuries reported by all operating companies during the period 1924 to 1928, there were 9 permanent total disability cases, 143 permanent partial disabilities, and 5,060 other injuries involving the loss of more than 14 days' time.

Table 2.-Fatal accident rates, relative standing, and frequency rating of Colorado coal companies, 1913 - 1928

| | | Deaths per thousand 300-day workers |
|---|---|---|
| 1. | Shamrock Coal Co. | 0.00 |
| 2. | Clayton Coal Co. | 1.13 |
| 3. | North Park Coal Co. | 2.37 |
| 4. | Dick Coal Co. | 2.62 |
| 5. | Consolidated Coal & Coke Co. | 3.07 |
| 6. | Huerfano Coal Co. | 3.30 |
| 7. | Grand Junction Mining and Fuel Co. | 3.70 |
| 8. | Aztec Coal Mining Co. | 3.84 |
| 9. | Leyden Lignite Co. | 4.20 |
| 10. | Pikes Peak Fuel Co. | 4.54 |
| 11. | Colorado Fuel and Iron Co. | 4.84 |
| 12. | National Fuel Co. | 5.29 |
| 13. | Royal Fuel Co. | 5.52 |
| 14. | Calumet Fuel - Utah Fuel Co. | 6.05 |
| 15. | Colorado Springs Co. | 6.12 |
| 16. | W. E. Russell Coal Co. | 6.79 |
| 17. | Rocky Mountain Fuel Co. | 7.30 |
| 18. | Crested Butte Coal Co. | 7.34 |
| 19. | American Smelting & Refining Co. | 8.54 |
| 20. | Boulder Valley Coal Co. | 8.98 |
| 21. | Juanita Coal & Coke Co. | 9.15 |
| 22. | Caliente Coal Co. | 9.22 |
| 23. | Colorado & Utah Coal Co. | 9.86 |
| 24. | Mutual Coal Co. | 10.64 |
| 25. | Hayden Brothers Coal Corporation | 10.71 |
| 26. | Canon Reliance Coal Co. | 11.60 |
| 27. | Temple Fuel Co. | 12.54 |
| 28. | Alamo Coal Co. | 12.64 |
| 29. | Bear Canon Coal Co. | 15.65 |
| 30. | Gordon Coal Co. | 15.71 |
| 31. | Moffat Coal Co. | 15.73 |
| 32. | Victor American Fuel Co. | 15.88 |
| 33. | Oakdale Coal Co. | 20.25 |
| 34. | Empire Coal Mining Co. | 31.14 |
| | Average 34 companies | 7.53 |

Table 3.-Fatal accident rates, relative standing, and tonnage rating of Colorado coal companies, 1913 - 1928

| | | Deaths per 1,000,000 tons produced |
|---|---|---|
| 1. | Shamrock Coal Co. | 0.00 |
| 2. | Clayton Coal Co. | 0.61 |
| 3. | North Park Coal Co. | 1.53 |
| 4. | Consolidated Coal and Coke Co. | 1.75 |
| 5. | Dick Coal Co. | 2.22 |
| 6. | Grand Junction Mining and Fuel Co. | 2.27 |
| 7. | Pikes Peak Fuel Co. | 2.73 |
| 8. | Huerfano Coal Co. | 3.01 |
| 9. | Leyden Lignite Co. | 3.40 |
| 10. | National Fuel Co. | 3.70 |
| 11. | Boulder Valley Coal Co. | 3.77 |
| 12. | Colorado & Utah Coal Co. | 3.84 |
| 13. | Calumet Fuel – Utah Fuel Co. | 3.89 |
| 14. | Aztec Coal Mining Co. | 4.32 |
| 15. | W. E. Russell Coal Co. | 4.36 |
| 16. | Juanita Coal & Coke Co. | 4.60 |
| 17. | Royal Fuel Co. | 4.83 |
| 18. | Crested Butte Coal Co. | 4.97 |
| 19. | Colorado Fuel & Iron Co. | 5.09 |
| 20. | Rocky Mountain Fuel Co. | 5.10 |
| 21. | Colorado Springs Co. | 5.63 |
| 22. | Hayden Brothers Coal Corporation | 6.38 |
| 23. | Moffat Coal Co. | 6.64 |
| 24. | American Smelting & Refining Co. | 7.04 |
| 25. | Mutual Coal Co. | 8.45 |
| 26. | Temple Fuel Co. | 11.98 |
| 27. | Caliente Coal Co. | 12.08 |
| 28. | Canon Reliance Coal Co. | 12.25 |
| 29. | Victor-American Fuel Co. | 13.67 |
| 30. | Alamo Coal Co. | 14.03 |
| 31. | Bear Canon Coal Co. | 15.44 |
| 32. | Gordon Coal Co. | 16.46 |
| 33. | Oakdale Coal Co. | 19.31 |
| 34. | Empire Coal Mining Co. | 23.69 |
| | Average 34 companies | 6.38 |

Table 5.-Fatal accident rates, relative standing, and frequency rating of Colorado coal companies, 1924 - 1928

| | | Deaths per thousand 300-day workers |
|---|---|---|
| 1. | Shamrock Coal Co. | 0.00 |
| 2. | Aztec Coal Co. | 0.00 |
| 3. | Consolidated Coal & Coke Co. | 0.00 |
| 4. | Clayton Coal Co. | 1.54 |
| 5. | Grand Junction Mining & Fuel Co. | 2.05 |
| 6. | Dick Coal Co. | 3.18 |
| 7. | Leyden Lignite Co. | 3.30 |
| 8. | Colorado Fuel & Iron Co. | 4.22 |
| 9. | National Fuel Co. | 4.26 |
| 10. | Pikes Peak Fuel Co. | 4.32 |
| 11. | American Smelting & Refining Co. | 4.44 |
| 12. | Royal Fuel Co. | 4.47 |
| 13. | North Park Coal Co. | 4.59 |
| 14. | Calumet Fuel Co. — Utah Fuel Co. | 4.79 |
| 15. | W. E. Russell Coal Co. | 4.85 |
| 16. | Rocky Mountain Fuel Co. | 6.01 |
| 17. | Huerfano Coal Co. | 6.19 |
| 18. | Crested Butte Coal Co. | 6.68 |
| 19. | Mutual Coal Co. | 6.93 |
| 20. | Alamo Coal Co. | 7.40 |
| 21. | Colorado Springs Co. | 7.87 |
| 22. | Temple Fuel Co. | 8.21 |
| 23. | Boulder Valley Coal Co. | 8.44 |
| 24. | Colorado & Utah Coal Co. | 8.98 |
| 25. | Caliente Coal Co. | 9.22 |
| 26. | Victor American Fuel Co. | 9.94 |
| 27. | Canon Reliance Coal Co. | 11.13 |
| 28. | Moffat Coal Co. | 11.79 |
| 29. | Oakdale Coal Co. | 12.16 |
| 30. | Empire Coal Mining Co. | 13.85 |
| 31. | Gordon Coal Co. | 17.27 |
| 32. | Juanita Coal & Coke Co. | 22.00 |
| 33. | Hayden Brothers Coal Corp. | 22.18 |
| 34. | Bear Canon Coal Co. | 27.62 |
| | Average 34 companies | 5.99 |

## TABLE 4: ACCIDENT RECORD - COLORADO COAL-MINING COMPANIES

(Compiled from annual reports of State Inspector of Coal Mines.)

| Company | Period company has operated | No. mines operated during all or part of | | Total tonnage production | | Man days worked | | Fatalities | | Deaths per 1,000 300-day workers | | Deaths per 1,000,000 tons produced | | No. injured 1924 to 1928 | Injured per 1,000 300-day workers 1924 to 1928 | Injured per 1,000,000 tons production 1924 to 1928 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1913 to 1928 | 1924 to 1928 | 1913 to 1928 | 1924 to 1928 | 1913 to 1928 | 1924 to 1928 | 1913 to 1928 | 1924 to 1928 | 1913 to 1928 | 1924 to 1928 | 1913 to 1928 | 1924 to 1928 | | | |
| 1. Alamo Coal Co. | 1923-28 | 1 | 1 | 498,833 | 495,492 | 166,198 | 162,183 | 7 | 4 | 12.64 | 7.40 | 14.03 | 8.07 | 117 | 216.42 | 236.13 |
| 2. American Smelting & Refining Co. | 1917-28 | 3 | 2 | 2,840,118 | 1,338,117 | 702,277 | 337,663 | 20 | 5 | 8.54 | 4.44 | 7.04 | 3.74 | 295 | 262.10 | 220.46 |
| 3. Aztec Coal Min. Co. | 1914-28 | 1 | 1 | 693,838 | 293,294 | 234,623 | 74,014 | 3 | 0 | 3.84 | 0.00 | 4.32 | 0.00 | 28 | 113.49 | 95.47 |
| 4. Bear Canon Coal Co. | 1917-28 | 2 | 2 | 712,239 | 336,720 | 210,848 | 86,889 | 11 | 8 | 15.65 | 27.62 | 15.44 | 23.76 | 45 | 155.37 | 133.64 |
| 5. Boulder Valley Coal Co. | 1917-28 | 2 | 2 | 1,589,693 | 1,259,002 | 200,352 | 142,165 | 6 | 4 | 8.98 | 8.44 | 3.77 | 3.18 | 110 | 232.12 | 87.37 |
| 6. Caliente Coal Co. | 1924-28 | 2 | 2 | 496,549 | 496,549 | 195,197 | 195,197 | 6 | 6 | 9.22 | 9.22 | 12.08 | 12.08 | 81 | 124.49 | 163.13 |
| 7. Calumet Fuel Co. and Utah Fuel Co | 1913-28 | 4 | 4 | 6,433,154 | 2,498,970 | 1,239,454 | 438,037 | 25 | 7 | 6.05 | 4.79 | 3.89 | 2.80 | 161 | 110.27 | 64.43 |
| 8. Canon Reliance Coal Co. | 1919-28 | 2 | 1 | 816,381 | 322,596 | 258,619 | 80,836 | 10 | 3 | 11.60 | 11.13 | 12.25 | 9.30 | 94 | 348.86 | 291.39 |
| 9. Clayton Coal Co. | 1920-28 | 1 | 1 | 1,626,918 | 1,219,772 | 266,370 | 195,429 | 1 | 1 | 1.13 | 1.54 | 0.61 | 0.82 | 121 | 185.75 | 99.20 |
| 10. Colo. Fuel and Iron Co. | 1913-28 | 33 | 25 | 50,483,069 | 14,823,496 | 15,941,000 | 3,626,488 | 257 | 51 | 4.84 | 4.22 | 5.09 | 3.44 | 2782 | 230.14 | 187.68 |
| 11. Colorado Springs Co. | 1919-28 | 1 | 1 | 533,278 | 264,412 | 147,133 | 76,234 | 3 | 2 | 6.12 | 7.87 | 5.63 | 7.56 | 55 | 216.44 | 208.01 |
| 12. Colo. & Utah Coal Co. | 1914-28 | 1 | 1 | 3,124,445 | 1,059,625 | 364,951 | 100,261 | 12 | 3 | 9.86 | 8.98 | 3.84 | 2.83 | 188 | 562.53 | 177.42 |
| 13. Consolidated Coal & Coke Co. | 1913-28 | 1 | 1 | 1,714,083 | 645,954 | 293,322 | 79,264 | 3 | 0 | 3.07 | 0.00 | 1.75 | 0.00 | 44 | 166.53 | 68.12 |
| 14. Crested Butte Coal Co. | 1914-28 | 1 | 1 | 402,270 | 252,103 | 81,715 | 44,908 | 2 | 1 | 7.34 | 6.68 | 4.97 | 3.97 | 13 | 86.84 | 51.57 |
| 15. Dick Coal Co. | 1921-28 | 1 | 1 | 449,902 | 379,973 | 114,643 | 94,308 | 1 | 1 | 2.62 | 3.18 | 2.22 | 2.63 | 42 | 133.61 | 110.53 |
| 16. Empire Coal Mining Co. | 1917-28 | 1 | 1 | 717,607 | 370,762 | 163,761 | 64,988 | 17 | 3 | 31.14 | 13.85 | 23.69 | 8.09 | 25 | 115.41 | 67.43 |
| 17. Gordon Coal Co. | 1913-28 | 1 | 1 | 729,155 | 266,618 | 229,195 | 86,877 | 12 | 5 | 15.71 | 17.27 | 16.46 | 18.75 | 30 | 103.59 | 112.52 |
| 18. Grand Junction Mining and Fuel Co. | 1913-28 | 2 | 2 | 2,200,715 | 904,525 | 405,537 | 146,304 | 5 | 1 | 3.70 | 2.05 | 2.27 | 1.11 | 94 | 192.75 | 103.92 |
| 19. Hayden Bros. Coal Corp. | 1914-28 | 1 | 1 | 1,096,644 | 595,487 | 196,144 | 67,635 | 7 | 5 | 10.71 | 22.18 | 6.38 | 8.40 | 100 | 443.56 | 167.93 |
| 20. Huerfano Coal Co. | 1913-28 | 1 | 4 | 1,328,979 | 366,537 | 363,453 | 97,007 | 4 | 2 | 3.30 | 6.19 | 3.01 | 5.45 | 48 | 148.44 | 130.92 |
| 21. Juanita Coal & Coke Co. | 1913-28 | 1 | 1 | 1,088,119 | 259,029 | 163,932 | 27,271 | 5 | 2 | 9.15 | 22.00 | 4.60 | 7.72 | 28 | 308.02 | 108.10 |
| 22. Leyden Lignite Co. | 1913-28 | 2 | 1 | 2,058,450 | 489,456 | 499,519 | 90,772 | 7 | 1 | 4.20 | 3.30 | 3.40 | 2.04 | 36 | 118.98 | 73.55 |
| 23. Moffat Coal Co. | 1913-28 | 3 | 3 | 4,068,299 | 1,223,685 | 514,871 | 76,343 | 27 | 3 | 15.73 | 11.79 | 6.64 | 2.45 | 257 | 1009.92 | 210.02 |
| 24. Mutual Coal Co. | 1913-28 | 1 | 1 | 1,420,587 | 336,211 | 338,470 | 86,618 | 12 | 2 | 10.64 | 6.93 | 8.45 | 5.95 | 117 | 405.23 | 348.00 |
| 25. National Fuel Co. | 1913-28 | 6 | 3 | 6,758,247 | 2,657,949 | 1,418,921 | 562,924 | 25 | 8 | 5.29 | 4.26 | 3.70 | 3.01 | 562 | 299.51 | 211.44 |
| 26. North Park Coal Co. | 1915-28 | 2 | 2 | 655,399 | 317,296 | 126,447 | 65,427 | 1 | 1 | 2.37 | 4.59 | 1.53 | 3.15 | 54 | 247.60 | 170.19 |
| 27. Oakdale Coal Co. | 1913-28 | 1 | 1 | 2,382,115 | 387,048 | 681,571 | 123,306 | 46 | 5 | 20.25 | 12.16 | 19.31 | 12.92 | 72 | 175.17 | 186.02 |
| 28. Pikes Peak Fuel Co. | 1913-28 | 3 | 2 | 3,293,534 | 1,203,260 | 594,286 | 208,134 | 9 | 3 | 4.54 | 4.32 | 2.73 | 2.49 | 97 | 139.81 | 80.61 |
| 29. Rocky Mountain Fuel Co. | 1913-28 | 25 | 12 | 14,502,837 | 3,736,636 | 3,042,608 | 699,335 | 74 | 14 | 7.30 | 6.01 | 5.10 | 3.75 | 773 | 331.60 | 206.87 |
| 30. Royal Fuel Co. | 1913-28 | 1 | 1 | 2,277,065 | 787,903 | 598,312 | 201,376 | 11 | 3 | 5.52 | 4.47 | 4.83 | 3.81 | 51 | 75.98 | 64.73 |
| 31. W. E. Russel Coal Co. | 1914-28 | 1 | 1 | 918,267 | 352,893 | 176,817 | 61,862 | 2 | 1 | 6.79 | 4.85 | 4.36 | 2.83 | 33 | 160.03 | 93.51 |
| 32. Shamrock Coal Co. | 1914-28 | 1 | 1 | 771,853 | 358,120 | 105,131 | 48,184 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 8 | 49.81 | 22.34 |
| 33. Temple Fuel Co. | 1914-28 | 3 | 1 | 2,003,004 | 663,790 | 574,174 | 219,212 | 24 | 6 | 12.54 | 8.21 | 11.98 | 9.04 | 92 | 125.91 | 138.60 |
| 34. Victor American Fuel Co. | 1913-28 | 13 | 7 | 15,508,919 | 3,966,532 | 4,005,053 | 905,687 | 212 | 30 | 15.88 | 9.94 | 13.67 | 7.56 | 1505 | 498.52 | 379.42 |
| Total or average | | 125 | 89 | 136,194,561 | 44,929,914 | 34,614,900 | 9,573,135 | 869 | 191 | 7.53 | 5.99 | 6.38 | 4.25 | 8158 | 255.65 | 181.57 |

Table 6.-Fatal accident rates, relative standing, and tonnage rating of Colorado coal companies, 1924 - 1928

| | | Deaths per 1,000,000 tons produced |
|---|---|---|
| 1. | Shamrock Coal Co. | 0.00 |
| 2. | Aztec Coal Co. | 0.00 |
| 3. | Consolidated Coal & Coke Co. | 0.00 |
| 4. | Clayton Coal Co. | 0.82 |
| 5. | Grand Junction Mining & Fuel Co. | 1.11 |
| 6. | Leyden Lignite Co. | 2.04 |
| 7. | Moffat Coal Co. | 2.45 |
| 8. | Pikes Peak Fuel Co. | 2.49 |
| 9. | Dick Coal Co. | 2.63 |
| 10. | Calumet Fuel Co. - Utah Fuel Co. | 2.80 |
| 11. | W. E. Russell Coal Co. | 2.83 |
| 12. | Colorado and Utah Co. | 2.83 |
| 13. | National Fuel Co. | 3.01 |
| 14. | North Park Coal Co. | 3.15 |
| 15. | Boulder Valley Coal Co. | 3.18 |
| 16. | Colorado Fuel and Iron Co. | 3.44 |
| 17. | American Smelting & Refining Co. | 3.74 |
| 18. | Rocky Mountain Fuel Co. | 3.75 |
| 19. | Royal Fuel Co. | 3.81 |
| 20. | Crested Butte Coal Co. | 3.97 |
| 21. | Huerfano Coal Co. | 5.45 |
| 22. | Mutual Coal Co. | 5.95 |
| 23. | Colorado Springs Co. | 7.56 |
| 24. | Victor American Fuel Co. | 7.56 |
| 25. | Juanita Coal and Coke Co. | 7.72 |
| 26. | Alamo Coal Co. | 8.07 |
| 27. | Empire Coal Mining Co. | 8.09 |
| 28. | Hayden Brothers Coal Corp. | 8.40 |
| 29. | Temple Fuel Co. | 9.04 |
| 30. | Canon Reliance Coal Co. | 9.30 |
| 31. | Caliente Coal Co. | 12.08 |
| 32. | Oakdale Coal Co. | 12.92 |
| 33. | Gordon Coal Co. | 18.75 |
| 34. | Bear Canon Coal Co. | 23.76 |
| | Average 34 companies | 4.25 |

## COAL-MINE DISASTERS IN COLORADO

At least 771 lives have been lost in coal-mine disasters in Colorado since 1884; of this number 740 lives were lost in explosions, 10 in an inrush of water, and 21 in mine fires. During the period 1913 to 1928, 6 lives were lost in a mine fire and 256 lives were lost in 15 explosions. The record for the five-year period 1924 to 1928 is exceptionally good; only 5 explosions, resulting in the death of 18 men, occurred, and the greatest number of lives lost in one disaster was 7; in 1924, 1 explosion occurred, killing 1 man; in 1925, 3 men lost their lives in an explosion; in 1926, 2 explosions occurred, resulting in the death of 7 men; and no explosions occurred in 1928. A list of coal-mine disasters occurring in Colorado since 1884, and the alleged causes are given in Table 7, the data for which were taken chiefly from published reports of the Colorado State Inspection Department.

Table 7.—Coal-mine disasters in Colorado, 1884 to 1928

| Date | Mine | Kind of disaster and alleged cause | Killed |
|---|---|---|---|
| Jan.24,1884 | Crested Butte | Gas and dust explosion, ignited by lamp | 59 |
| Sept.9,1889 | White Ash | Inrush of water from abandoned shaft | 10 |
| Jan.10,1893 | Como | Gas and dust explosion, blown-out shot | 24 |
| Feb.18,1896 | Vulcan | Gas and dust explosion, shot in chute | 49 |
| Sept.3,1897 | Sunshine | Dust explosion, ignited by shots | 12 |
| Sept.16,1901 | Spring Gulch | Dust explosion, blown-out shot | 6 |
| Aug.7,1902 | Bowen | Dust explosion, ignited by giant powder | 13 |
| Oct.28,1904 | Tercio | Dust explosion, ignited by blown-out shot | 19 |
| Feb.19,1906 | Maitland | Gas explosion, ignited by open lights | 14 |
| Apr.22,1906 | Cuatro | Gas and dust explosion, ignited by open light | 18 |
| Jan.23,1907 | Primero | Gas and dust explosion, ignited by safety lamp | 24 |
| May 19,1907 | Engleville | Mine fire | 5 |
| July 6,1909 | Toller | Gas explosion, ignited by open light | 9 |
| Jan.31,1910 | Primero | Gas and dust explosion, cause undetermined | 75 |
| Oct.8,1910 | Starkville | Dust explosion, runaway trip | 56 |
| Nov.8,1910 | Delagua | Gas and dust explosion, caused by fire | 79 |
| Dec.14,1910 | Leyden | Fire, cause unknown | 10 |
| Feb.9,1911 | Cokedale | Dust explosion, blown out shot | 17 |
| June 18,1912 | Hastings | Gas explosion, caused by defective safety lamp | 12 |
| Aug.12,1912 | Piedmont | Gas explosion, caused by open light | 2 |
| Oct.1,1912 | South Canon | Gas and dust explosion, probably blown-out shot | 2 |
| Dec.16,1913 | Vulcan | Dust explosion, open light or explosives | 37 |
| May 2,1915 | Mutual | Gas explosion, ignited by mining machine | 2 |
| Apr.27,1917 | Hastings | Gas and dust explosion, open safety lamp | 121 |
| Nov.4,1918 | Vulcan | Gas explosion, ignited by fire | 3 |
| Mar.31,1919 | Empire | Gas explosion, arc from short-circuited wires | 13 |
| Aug.18,1919 | Oakdale | Gas explosion, defective safety lamp | 18 |
| Feb.12,1921 | Oak Hills | Dust explosion caused by blown-out shots | 5 |
| Dec.13,1921 | Satanic | Mine fire | 6 |

Table 7.—Coal-mine disasters in Colorado, 1884 to 1928-Continued

| Date | Mine | Kind of disaster and alleged cause | Killed |
|---|---|---|---|
| Mar.24,1922 | Sopris | Gas and dust explosion, caused by electric arc | 17 |
| May 5,1923 | Southwestern | Gas and dust explosion, caused by open light | 10 |
| Oct.7,1923 | Midwest | Gas and dust explosion, caused by open light | 6 |
| Aug.5,1924 | Alamo | Gas and dust explosion, ignited by flame used to to light fuses | 1 |
| June 9,1925 | Gordon | Gas explosion, ignited by arc from min. machine | 3 |
| Jan.23,1926 | Harvey Gap | Gas and dust explosion, caused by open light | 3 |
| Jan.29,1926 | Bear Canon No.3 | Gas explosion, caused by open lights | 4 |
| May 27,1927 | Delagua | Coal-dust explosion, caused by electric arc | 7 |
| No mine explosions in 1928 | | | |
| Total deaths | | | 673 |

During the period 1884 to 1928, open lights and defective lamps resulted in 15 explosions causing the death of 338 men; during the period 1913 to 1928, 8 explosions from the same cause occurred, resulting in 200 deaths; and in the five-year period, 1924 to 1928, 3 explosions, causing 8 fatalities, occurred. Blown-out shots and explosives caused 9 explosions and 222 deaths from 1884 to 1928, 1 explosion and 5 deaths from 1913 to 1928, and no explosions or deaths since 1924. Electric arcs or sparks caused 6 explosions, resulting in 98 deaths during the above 45-year period, and 5 explosions from this cause resulting in 42 fatalities occurred from 1913 to 1928; 2 explosions and 10 deaths occurred from explosions of electrical origin during the 5-year period, 1924 to 1928. Mine fires, in the 45-year period, caused the death of 10 men in one disaster and caused 4 mine explosions, resulting in the death of 93 men; during the period 1913 to 1928, 2 explosions were caused by mine fires, resulting in the loss of 9 lives; mine fires caused no fatalities during the period 1924 to 1928.

Since 1913 the chief causes of mine disasters in Colorado have been electric arcs or sparks and open lights or flame safety lamps which were defective or were opened for relighting in the presence of explosive gas. Since 1924 all explosions reported were caused by open lights or electricity. This condition exists not only in the coal mines of Colorado but also in the coal mines of all coal-mining districts, and is the result of failure on the part of mine owners to recognize the dangers of open lights and open-type electrical equipment. Many so-called nongassy coal mines are slightly gassy at all times, and at intervals they become decidedly gassy. In such mines when bodies of gas are liberated unexpectedly or when through some ventilation interruption there is an accumulation of methane, men wearing open lights frequently walk into the gas and ignite it, thus causing an explosion and killing many men. Some coal-mine operators who realize this hazard have installed permissible electric cap lamps and have forbidden the use of open lights in their mines; unfortunately the electric cap lamps are usually installed after a disaster has occurred because of failure to use such equipment previously. The large number of operators who have failed to take this precaution or have unduly delayed in taking it are responsible for the many explosions and fires caused by open lights not only in Colorado but in many other States. The coal-mine operator who installs closed lights and yet allows officials to use key-locked flame safety lamps to test for gas, who uses open-type electric equipment instead of the much safer and more serviceable permissible types, has really added a hazard to his mining operations, for the men have a false feeling of security and are very likely to take undue liberties with the nonpermissible equipment. All mine operators should require permissible electric cap lamps to be worn by all underground employees; but the mine ventilation practices should not be relaxed in the slightest degree, the underground equipment should be of permissible type wherever possible, and all parts liable to give off arcs or sparks should be inspected frequently and maintained in a safe operating condition; this is of particular importance at present when so much electrically operated machinery is being introduced at or near the working faces.

## CONCLUSIONS

1. Colorado coal-mine fatality rates have decreased steadily since 1914 and have decreased markedly since 1924.

2. The accident records of 34 of the principal coal-producing companies in the State of Colorado have been taken as a basis of comparison with similar records of the United States.

3. Accident figures on a tonnage basis are strictly cost figures; true comparison from the viewpoint of safety to the worker is on the basis of accident frequency or man hours of exposure.

4. On the basis of deaths per thousand 300-day workers the rate in Colorado for 1913 to 1928 was 7.53, as compared with 4.36 for the United States, showing that Colorado coal mining for this period was done much less safely than the average for the united States.

5. The fatality rate on the 1,000,000 tons production basis from 1913 to 1928 was 6.38 in Colorado, as compared with 4.52 for the United States. Here again Colorado coal mining showed to a disadvantage as compared with the average for the United States.

6. The Shamrock Coal Co. operated from 1914 to 1928 without a fatality, producing 771,853 tons of coal and working 105,131 man days. The Clayton Coal Co. operated nine years with only one fatality, producing 1,626,918 tons of coal and working 266,370 man days. These very good records indicate that at least in some parts of Colorado, coal mining can be conducted relatively safely.

7. During the period 1924 to 1928 the accident rates, compared with the period 1913 to 1928, decreased from 7.53 to 5.99 deaths per thousand 300-day workers and from 6.38 to 4.35 deaths per 1,000,000 tons produced. This decrease was due largely to the fewer deaths from explosions, as only one major explosion occurred in this five-year period.

8. Coal-mine disasters in Colorado have taken a toll of 771 men from 1884 to 1928, 740 of which lost their lives in mine explosions, 21 in mine fires, and 10 in an inrush of water.

9. During the five-year period, 1924 to 1928, five coal-mine explosions occurred, resulting in the loss of 18 lives. This compares very favorably with the record for the five-year period 1909 to 1913, when there were 10 explosions and fires with 299 resultant fatalities.

10. From 1884 to 1928 open lights and defective lamps caused 15 explosions, resulting in the loss of 338 lives; blown-out shots and explosives caused 8 explosions involving the lives of 200 men; electric arcs caused 6 explosions causing 98 fatalities; mine fires and the explosions resulting therefrom caused the death of 103 men; and one inrush of water caused the death of 10 men.

11. From 1924 to 1928, open lights and defective safety lamps caused 3 explosions with 8 fatalities, and electric arcs and sparks caused 2 explosions resulting in the loss of 10 lives.

12. All coal mines are potentially gassy and open lights are hazardous in even so-called nongassy coal mines. Many of Colorado's mine explosions have very definitely indicated the truth of this.

13. To secure maximum safety the installation of closed lights must be accompanied by the most rigid care in mine ventilation and by the installation of permissible electric equipment wherever possible.

The data from which this paper was prepared were taken largely from the Annual Reports of the Colorado State Inspection Department. It was due chiefly to the completeness of the figures and other data contained in the reports by that department that the information in this paper could be made available.